

# NAVAL HEALTH RESEARCH CENTER

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## *A DESCRIPTIVE ANALYSIS OF DENTAL CONDITIONS OCCURRING DURING CONFLICTS, DEPLOYMENTS, AND FIELD TRAINING EXERCISES*

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# **A DESCRIPTIVE ANALYSIS OF DENTAL CONDITIONS OCCURRING DURING CONFLICTS, DEPLOYMENTS, AND FIELD TRAINING EXERCISES**

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## **Summary**

### **Background**

Threats to US security are continually changing and are now more global and diverse. Current and future strategic deployment plans, as expressed in the doctrinal guidance “Operational Maneuver from the Sea,” are no longer structured for large or lengthy buildup on shore. The challenges set forth by current and future threats and the mandate to increase speed and mobility have contributed to the need to review the current Authorized Dental Allowance List.

### **Objective**

The primary objective of Phase I of this study was to identify the dental conditions and their rate of occurrence in conflicts, deployments, and field training exercises (FTXs). This information will be used in Phase II to generate the supplies and equipment needed for treatment of a given dental patient stream. Dental conditions will then be linked to dental tasks. Supplies needed to treat each procedure will then be identified.

### **Approach**

Data were gathered from scientific journals and after-action reports. A list of the dental conditions that might be expected to present in a theater of operations was developed based on these data.

### **Results**

Results of the study showed that the average dental condition rate across conflicts, deployments and FTXs was 17.9 per 1000 troops/month. Dental rates for conflicts ranged from 12.4 to 17.5, with an average of 12.52. Sinai deployment data revealed a rate of 13.3, and the FTX rates ranged from 7.2 to 37.3, with an average of 17.01 per 1000 troops/month. The final list of dental conditions comprises 38 dental conditions.

### **Conclusion**

Determining the likely distribution of dental casualty rates is essential to resource planners and logisticians to determine the amount and composition of dental equipment and supplies required for an operation. The mission of dental and data collection standards and factors that influence dental incidence rates should be considered when estimating dental casualty rates.

# **A DESCRIPTIVE ANALYSIS OF DENTAL CONDITIONS OCCURRING DURING CONFLICTS, DEPLOYMENTS, AND FIELD TRAINING EXERCISES**

## **INTRODUCTION**

Threats to US security are continually changing and are now more global and diverse. Current and future strategic deployment plans, as expressed in the doctrinal guidance "Operational Maneuver from the Sea," are no longer structured for large or lengthy buildup on shore.<sup>1</sup> Maintenance of large force buildup in a few locations has been replaced with a policy of rapid global force projection supported by strategic lift. Strategic lift and mobility define the effectiveness of force projections. All areas of the Marine Corps must respond to the challenge of this concept to ensure mobility and combat readiness.

The primary goal set forth by the Naval Dental Corps which supports the Fleet Marine Force (FMF) is to provide dental health and maintenance of Marine Corps forces. The mission of these Dental Units is to maximize dental readiness of supported troops in garrison and maintain dental readiness of troops during training exercises, deployments, operations other than war, and combat operations. Secondly, Dental Battalions augment Medical Services during casualty overload.<sup>2</sup> According to the Marine Corps Health Service Support, the Dental Battalion's primary mission is to provide dental health maintenance with a focus on emergency care. Dental support is designed to provide dental care that allows personnel to be treated as far forward as possible, reducing the time and resources needed to evacuate personnel to a higher echelon of care. Far-forward dental support also helps to reduce or eliminate the effects of dental disease and injury. This mission is accomplished through the employment of the Authorized Dental Allowance List (ADAL) 662 Field Dental Operator. ADAL 662 contains equipment and reusable materiel required to establish a dental clinic in the field. It also contains consumable supplies required to provide emergency, diagnostic, and preventive dental care for 400 patients.<sup>3</sup>

As a result of the Mission Area Analysis--45 Health Service Support (October 21-25, 1996), the Marine Corps Dental Command reevaluated ADAL 662 and made changes that included the introduction of a lighter dental chair. These changes reduced the cube and weight of ADAL 662. Recent changes in the tempo, mobility, and momentum set forth by Marine Corps doctrine and policy have contributed to the need to further review the current ADAL. The successful changes seen in the reorganization of medical supplies using the systematic approach developed by the Naval Health Research Center (NHRC) prompted the development of a similar approach for ADAL 662.

NHRC used a systematic process to greatly reduce the weight and cube of the Authorized Medical Allowance Lists (AMALs), while also providing upgrades in technology and medical capabilities.<sup>4-9</sup> A standard of care was identified, and the clinical requirements for items needed to attain that level of care were established. Supply requirements were based on an estimated casualty patient stream. The flexibility provided by this approach allows the AMALs to be adapted and configured to support different war-fighting concepts and missions as they emerge. The revised AMALs were designed to be mission-specific so that the supply stream reflects

changes in the technology and the mission. Logistics are facilitated with a smaller footprint, and medical capabilities are enhanced with better technology.

This approach of linking clinical requirements to supply items will be used to develop task-driven supply requirements and to enhance the technology, flexibility, and mobility of ADAL 662 during Phase II. This study describes Phase I of this project, which identifies the dental conditions and their rate of occurrence during conflicts, deployments, and field training exercises (FTXs). Phase II will link the conditions to dental procedures and construct profiles detailing the supplies required to complete each procedure. Finally, the mix and amount of supplies will be based on a mission-specific dental patient stream.

## BACKGROUND

Dental conditions constitute 10% to 22% of all emergency health visits during conflicts, deployments, and FTXs.<sup>10-14</sup> Although dental conditions (with the exception of maxillofacial injuries and oral infections) are seldom life-threatening, their effects can have a great impact on unit effectiveness, fighting strength, and morale of military personnel.<sup>10,13,14</sup> Therefore, the dental readiness of military personnel is very important for unit effectiveness.

### Dental Readiness and Classification

The Department of Defense (DoD) classification system prioritizes the treatment needs for military personnel and identifies individuals who are at risk to incur a dental emergency in less than 1 year.<sup>15,16</sup> Table 1 presents the description of the 4 dental classes. The classification system can be used as an indicator of unit readiness and as a predictor of dental treatment, disease management, and resource allocation. Personnel in Class 2 exhibit dental conditions such as early or mild periodontitis, caries with minimal extension into the dentin, and nonspecific gingivitis, while those in Class 3 exhibit dental conditions such as moderate-to-advanced periodontitis, caries that extend beyond the dentin enamel junction, acute gingivitis, pericoronitis, and trauma. For a complete listing, see DoD Instruction 6410.1, Standardization of Dental Classifications.<sup>15</sup>

**TABLE 1: DESCRIPTION OF DENTAL CLASSIFICATIONS**

<i>Class</i>	<i>Description</i>
1	Personnel in this class require no dental treatment.
2	Personnel in this class have been diagnosed with oral conditions that are not expected to result in dental emergencies within 12 months if not treated.
3	Personnel in this class have been diagnosed with oral conditions that are <i>expected</i> to result in dental emergencies within 12 months if not treated.
4	The oral conditions of personnel in this class are unknown.

Dental readiness refers to the dental health of personnel and is defined in terms of the percentage of personnel in dental Classes 1 and 2 combined. The dental fitness of personnel prior to operations is a critical issue to all commands. Recent policy directives mandate 95% dental

readiness among the active-duty forces.<sup>16</sup> Therefore, it is the goal of both combat commanders and combat support commanders to deploy personnel who are medically and dentally fit to fight. Military personnel are screened annually and placed into the appropriate dental classification according to their dental conditions. The rate of dental casualties drastically increases as the dental classification number increases.<sup>17</sup> It is obviously advantageous to deploy personnel who are less likely to experience dental problems.

The dental fitness of combat and combat support personnel prior to deployments can have a significant effect on the incidence of dental casualties. Most Marines are in dental fitness Class 2. According to the 1994 Tri-Service Comprehensive Oral Health Survey Report,<sup>18</sup> 3.7% of Marines are in Class 1, 83.3% are in Class 2, and 13.0% are in Class 3. McClave and Brokaw<sup>19</sup> found that 50% of Class 3 patients report to sick call within 12 months. Allen and Smith<sup>11</sup> reported that 85% of dental casualties occurring while deployed were previously identified as dental fitness Class 3. The criteria for placement in Class 3 status are operative, surgery, endodontics, and periodontics.<sup>19</sup> Class 3 patients add significantly to lost duty time and decrease combat readiness. Since individuals are considered to be dentally fit if they are classified as either Class 1 or 2, Dental Units focus their efforts to bring patients from Class 3 to a minimum of Class 2. The optimal classification is Class 1. It is estimated that the amount of time required by a dentist to bring a patient from Class 2 to Class 1 is 5.81 hours per patient.<sup>20</sup>

#### Dental Care Categories

Table 2 provides a description of the 4 types of dental care: emergency, sustaining, maintaining, and comprehensive. Emergency care includes treatments for conditions such as hemorrhage, oral/facial cellulitis, respiratory difficulties, and trauma to teeth, jaws, and associated facial structures. Sustaining care includes basic restorations, extractions, pulpectomy, treatment of periodontal conditions, and simple prosthetic repairs. Maintaining care includes restorative, exodontic, minor oral surgical, periodontic, endodontic, prosthodontic, and preventive procedures. The fourth category, comprehensive, is not usually available in the field. Comprehensive care includes treatments such as restorative maxillofacial, prosthodontics, extensive oral rehabilitation, and dental restoration.

**TABLE 2: DESCRIPTION OF TYPES OF DENTAL CARE**

<i>Level of Care</i>	<i>Description of Care</i>
Emergency Care	Treatment designed to relieve oral pain, eliminate acute infection, control life-threatening oral conditions.
Sustaining Care	Treatment necessary to intercept potential emergencies. This type of care is essential for prevention of lost duty time and preservation of fighting strength.
Maintaining Care	Treatment designed to maintain the overall oral fitness level consistent with combat readiness.
Comprehensive Care	Specialized treatment procedures accomplished at a fixed facility in the continental United States (CONUS).

Dental Units focus on maintaining dental readiness. On extended deployments, when time and conditions permit, Dental Units provide a wide range of treatment modalities similar to treatment



rendered in garrison. Personnel in Class 3 should receive sustaining care as the tactical situation permits, while those in Class 2 can be provided maintaining care as the situation and availability of dental resources permit.

During periods of high operational tempo, however, the functions of dental personnel change. Dental incidence rates are linked to several factors.<sup>21,22</sup> Deutsch and Simecek<sup>21</sup> noted that large fluctuations in the rate of emergencies occur during events of psychological importance and operational tempo. As described by Chisick and King,<sup>23</sup> armed conflicts and high-intensity combat have the potential to yield more serious casualties involving trauma and oral maxillofacial conditions. Medical personnel usually stabilize oral maxillofacial casualties until they can be transported to a higher level of care. Heavy training requirements, inclement weather, rough terrain, and limited availability of dental care (including transportation to and from the treatment facility) can decrease the incidence of dental casualties reporting to dental facilities. When the treatment facility is distant, transportation may affect the access to dental care. Based on availability of transportation to the treatment facility, substantial increases in lost duty time may occur during armed conflicts. It is estimated that 10.1 duty days per 1000 troops/month are lost due to dental casualties.<sup>10</sup> During Operation Desert Shield/Storm members of the ground forces were estimated to be absent for as many as 5 days for each dental visit.<sup>16</sup>

## METHOD

Deployment, conflict, and FTX data were collected from scientific journal articles and after-action reports. These data were analyzed to describe the types and occurrence of dental conditions. The dental incidence rates were calculated using the average number of months. Because few studies exist on deployments, deployment rates were based on the Teweles and King<sup>17</sup> Sinai Peninsula deployment only.

The initial list of 32 dental conditions proposed by King and Brunner<sup>24</sup> was used and then circulated to 20 subject matter experts (SMEs). The SMEs represented board-qualified specialists (Endodontist, Periodontist, Prosthodontist, General Dentist, Oral & Maxillofacial Surgeon, Exodontist, and Comprehensive Dentist). They were instructed to add to, delete from, or modify this list. The revised list of 38 dental conditions found in Appendix A is based on the findings from various studies and data provided by these SMEs.

The three settings studied in this report were conflicts, deployments, and FTXs. Conflicts, as used in this report, involve actual armed combat situations. A deployment involves relocation of forces and materiel to desired areas of operations outside CONUS during a contingency, war, or national emergency. Deployment data included noncombat deployments conducted in Somalia and Sinai. FTXs were conducted in the field under simulated war conditions in which troops and armament of one side were actually present, while those of the other side were imaginary or in outline. Data collected during Field Training Exercises were actual cases that occurred during training. The conditions that occurred during these operations were reported from sick call and emergencies. Data from FTXs are the most readily available. Data from 9 FTXs were provided

by the Marine Corps Forces Pacific Dental Officer.<sup>‡</sup> Although FTXs only simulate conditions of conflict, they provide useful information about the types of dental conditions that can occur. They also provide information on the dental health and risk associated with the dental fitness of the unit.

## RESULTS

The average dental condition rate across all three settings was 17.9 per 1000 troops/month. Dental rates for conflicts, as shown in Table 3, ranged from 12.4 to 17.5, with an average of 12.52. Table 4 shows the rate for the Sinai deployment was 13.3 per 1000 troops/month. The FTX rates, shown in Table 5, ranged from 7.2 to 37.3, with an average of 14.50 per 1000 troops/month.

**TABLE 3: DENTAL RATES DURING CONFLICTS**

<i>Investigators</i>	<i>Year</i>	<i>Description of Conflict</i>	<i>Duration (in days)</i>	<i>No. of Cases</i>	<i>Population at Risk</i>	<i>Dental Condition Rate (per 1000/month)</i>
Ludwick, Gendron, et al <sup>14</sup>	1969	Vietnam	90	3370	64,166	17.5
	1970	Vietnam	180	2398	30,533	13.1
Deutsch & Simecek <sup>21</sup>	1991	Kuwait	245	4776	47,515	12.4
<i>Total (based on average month)</i>			515	10,544	142,214	12.52

**TABLE 4: DENTAL RATES DURING DEPLOYMENTS**

<i>Investigators</i>	<i>Year</i>	<i>Description of Deployment</i>	<i>Duration (in days)</i>	<i>No. of Cases</i>	<i>Population at Risk</i>	<i>Dental Condition Rate (per 1000/month)</i>
Teweles & King <sup>17</sup>	1982	Sinai Peninsula, Egypt	154	39	579	13.3
Rathburn*	1992-1993	Somalia	47	297	—	—
<i>Total (based on average month)</i>			154	39	579	13.3

†Data collected by CAPT Rathburn, DC, USN, from December 20, 1992 to February 5, 1993, Somalia.

—not reported.

<sup>‡</sup> CAPT Charles J. Fairchild, DC, Marine Corps Forces Pacific, provided field exercise training data collected from 1996 to 1998.

**TABLE 5: DENTAL RATES DURING FIELD EXERCISES**

<i>Investigators</i>	<i>Year</i>	<i>Description of Exercise</i>	<i>Duration (in days)</i>	<i>No. of Cases</i>	<i>Population at Risk</i>	<i>Dental Condition Rate(per 1000/ month)</i>
Sumnicht*	1964	FTX (NV,AZ,CA)	133	1453	25,714	12.7
Payne & Posey <sup>10</sup>	1978	Empire Glacier-78	24	141	7500	23.5
	1978	Brave Shield-17	13	219	17,500	29.1
Parker, King, et al. *	1981	FTX (CA)	117	92	7745	19.5
King & Brunner <sup>24</sup>	1982	Carbine Fortress Autumn Forge	10	355	49,902	21.6
Fairchild <sup>†</sup>	1996	Freedom Banner-96	20	7	728	14.1
	1996	Ulchi Focus Lens-96	17	16	1400	19.7
	1996	Cobra Gold-96	23	12	650	24.0
	1997	Freedom Banner-97	30	30	805	37.3
	1997	Cobra Gold-97	20	13	950	20.7
	1997	Ulchi Focus Lens-97	24	14	1700	10.2
	1998	Foal Eagle-98	27	18	1100	18.2
	1998	Cobra Gold-98	20	27	2000	19.9
	1998	Ulchi Focus Lens-98	21	5	1000	7.2
<i>Total (based on average month)</i>			499	2402	118,694	14.50

\*Source: Chisick & King<sup>23</sup>

<sup>†</sup>Data collected by CAPT Charles J. Fairchild, DC, Marine Corps Forces Pacific, from 1996 to 1998.

The rate of FTX dental conditions was 8.27% and 13.58% higher than the rates during deployments and conflicts, respectively. Rate of dental conditions for deployment data were 5.79% higher than the rate during conflicts. Caries, third molar complications, periapical abscesses, and endodontics are consistently described as the major reasons for dental care in military populations.<sup>10-14,20-23</sup> Many of these dental conditions are often diagnosed in Class 3 personnel. It has been suggested that these primary causes of dental casualties during conflicts, deployments, and FTXs are preventable with proper diagnosis and early treatment.<sup>10,12,14</sup>

Table 6 shows the percentage of each dental condition across all operational settings. Data from Sumnicht<sup>23</sup> and Parker, King, et al<sup>23</sup> were not included because these studies did not report a breakdown of the dental conditions. Many of the reported dental conditions were put into categories to accommodate various grouping strategies. For example, the "Caries" category included lost or defective restorations and fractured teeth. The "Periodontal" category was grouped to include periodontal abscess, acute necrotizing gingivitis (ANUG), and gingivitis. "Soft tissue trauma" included lacerations. "Surgical postoperative" included osteitis. Finally, the "Other" category included drug reactions, unspecified infections, and unknown or unspecified conditions. A definition of each dental condition is provided in Appendix A.

**TABLE 6: PERCENTAGE OF DENTAL CONDITIONS REPORTED IN CONFLICTS, DEPLOYMENTS,  
AND  
FIELD TRAINING EXERCISES**

<b>Dental Conditions</b>	<b>Conflict (n = 9455)</b>	<b>Deployment (n = 39)</b>	<b>FTX (n = 857)</b>
Caries, lost/defective restoration, fractured tooth	45.69%	38.46%	48.31%
Pericoronitis, erupting tooth	17.28%	20.51%	14.59%
Periodontal	9.74%	7.69%	6.53%
Endodontic	8.81%	7.69%	4.20%
Trauma/occlusal trauma	4.38%	2.56%	1.40%
Other (drug reaction, infection, unknown)	4.37%	0.00%	3.27%
Surgical postoperative	3.78%	0.00%	0.23%
Prosthesis	3.01%	0.00%	3.73%
Postoperative	2.18%	2.56%	4.43%
Soft tissue trauma	0.76%	2.56%	0.82%
Alveolitis	0.00%	0.00%	1.40%
Apthous ulcer	0.00%	0.00%	0.93%
Candidiasis	0.00%	0.00%	0.12%
Facial wound/mand, max	0.00%	0.00%	1.52%
Fractured/loose crowns	0.00%	0.00%	1.87%
Herpes simplex	0.00%	0.00%	0.70%
Pain/swelling	0.00%	0.00%	0.35%
Periapical abscess	0.00%	12.82%	4.32%
Sialadenitis	0.00%	2.56%	0.35%
Sinusitis	0.00%	0.00%	0.93%
Traumatic ulcer	0.00%	2.56%	0.00%
<b>Total</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>

n = Total number of dental casualties

Caries, pericoronitis, periodontal, and endodontic were the top 4 conditions occurring during conflicts. During the Desert Shield/Storm conflict the top 3 dental conditions were caries (38.90%), pericoronitis (17.80%), and endodontic (15.40%).<sup>21</sup> In 1969, during the Vietnam conflict, 50.86% of dental conditions were caries and 16.00% were pericoronitis, but the third most common condition was periodontal at 9.14%.<sup>14</sup> In 1970 during the Vietnam conflict, 48.86% of the dental conditions were caries, 18.32% were pericoronitis, and 9.16% were periodontal.<sup>14</sup> During the Korean conflict caries and defective restorations accounted for approximately 42% of all treatments, and minor surgical procedures (primarily extractions) accounted for 23%.<sup>25</sup> The remaining treatments included periodontal treatment, bridges, crowns, dentures, and major surgical problems.

Deployment data also showed that caries were the number one dental condition. During the 22-week Sinai deployment, the top 3 dental conditions consisted of caries (38.46%), pericoronitis (20.50%), and periapical abscess (12.70%).<sup>17</sup> During the Somalia deployment, 40.40% of the 297 dental incidences were caries, 17.85% were endodontic, 15.15% were pericoronitis, and 12% were periodontal.<sup>†</sup>

<sup>†</sup> Data collected by CAPT Rathburn, DC, USN, from December 20, 1992 to February 5, 1993, Somalia.

During FTXs the top 3 conditions were caries (48.31%), pericoronitis (14.59%), and periodontal (6.53%), with caries accounting for almost half of the total dental conditions. The largest population supported during the FTXs was 49,902 during Carbine Fortress Autumn Forge. The rate of 21.6 per 1000 troops/month during this exercise was considerably lower than many of the other FTXs that supported as few as 805 troops.

Table 7 shows the rate per 1000 troops/month for conflict, deployment, and FTXs for each dental condition category.

**TABLE 7**  
**DENTAL CONDITION RATES FOR CONFLICTS, DEPLOYMENTS, AND FIELD TRAINING EXERCISES**

Dental Condition	Conflict	Deployment	FTX
Caries, lost/defective restoration, fractured tooth	5.13	5.05	6.98
Pericoronitis, erupting tooth	1.94	2.69	2.13
Endodontic	.99	1.01	.57
Periapical abscess	-----	1.68	.62
Other (drug reaction, infection, unknown)	.49	-----	.47
Fractured/loose crown	-----	-----	.18
Periodontal	1.09	1.01	.96
Trauma/occlusal trauma	.49	.34	.20
Sinusitis	-----	-----	.13
Apthous ulcer	-----	-----	.13
Postoperative	.24	.34	.64
Alveolitis	-----	-----	.20
Traumatic ulcer	-----	.34	-----
Prosthesis	.34	-----	.54
Sialadenitis	-----	.34	.05
Herpes simplex	-----	-----	.18
Pain/swelling	-----	-----	.05
Soft tissue trauma	.08	.34	.19
Surgical postoperative	.42	-----	.03
Candidiasis	-----	-----	.02
Fractured jaw	-----	-----	-----
Facial wound/mand, max	-----	-----	.22
Unspecified	1.29	-----	-----
<b>Total</b>	<b>12.53</b>	<b>13.30</b>	<b>14.50</b>

This table shows that the rate of dental casualties is greater during FTXs than deployments or conflict. The rate of caries, pericoronitis, and periodontal problems are very similar in all three settings. FTXs exhibited more types of dental conditions than conflicts or deployments. There were no reported cases of periapical abscess for conflicts and no reported cases of fractured jaws in any of the three settings.

## DISCUSSION

Dental casualties pose a significant hindrance to fulfillment of the Marine Corps mission.<sup>10,12,20</sup> Although it is imperative to reduce dental casualties, it is impossible to eliminate all dental problems in combat personnel. The results show that conflicts yield the lowest rate per 1000 troops/month of reported dental casualties when compared with deployments and FTXs. The fact that more conditions occur during FTXs might suggest that there is a greater need of care during these exercises. However, various studies indicate that incidence rates are influenced by a variety of factors, such as operational relevance, transportation, dental fitness, and personnel mix.

The first factor, operational relevance, refers to the mission scenario, either conflict, deployment, or FTX. During a conflict the tempo and threat are more intense than during deployments or FTXs. Personnel may wait until the threat is over before seeking dental care. During times of conflict or intense maneuvers, personnel tend to perform despite dental pain.<sup>22,25</sup> Keller<sup>25</sup> indicated that it is not uncommon to see a reduced rate of dental conditions during periods of increased operational tempo. He also reported that nearly 25% of personnel presenting with a chief complaint of dental pain had experienced that pain for more than 1 week.<sup>25</sup> Many troops endured the pain hoping it would subside with time and sought treatment only when the pain became too severe.

Accessibility to dental care depends in part on how close the dental unit is to troop location and the availability of transportation. The second factor, availability of transportation, is better during FTXs than in combat environments. This increase in the availability of care would assure an increase in the rate during FTXs versus conflicts.<sup>10</sup> This would explain the pattern of higher rates of dental incidence for FTXs than in conflict. Deployments, too, are confronted with transportation difficulties. Operational demands during deployments may limit or reduce transportation capabilities to and from dental facilities.

The third factor, dental fitness, refers to the classification of combat and combat support personnel prior to deployments. Dental fitness can have a significant effect on the incidence of dental casualties. As high as 74% of dental casualties are preventable.<sup>13</sup> They also noted a difference in classification among pay grades. Lower pay grades have a higher incidence rate of Class 3 personnel. As pay grade increases, the surgical need (wisdom tooth removal) decreases, while periodontics increase. Younger personnel usually join the military with wisdom teeth that eventually are removed. Consequently, higher ranking personnel who are usually older have their wisdom teeth removed earlier. Also, lower pay grades (E-1 through E-3) had a higher Class 3 rate (10.1%, 9.0%, and 7.3% respectively).<sup>11</sup> In contrast, higher ranking personnel (E-7 and E-8) have increased periodontal needs since these personnel are much older than those in lower ranks. A Class 3 patient has 4.8 times the risk of developing an acute dental problem in comparison with a Class 2 patient and 5.2 times the risk of a Class 1 patient. However, the chances of seeing a Class 1 or 2 patient for an acute problem is 3 times that of a Class 3 patient because the number of Class 1 and 2 personnel is almost 17 times the number of Class 3 personnel.<sup>16</sup>

The fourth factor, personnel mix, refers to the mixture of newly acquainted military personnel (including recruits) and career personnel. Recruits have a much greater requirement for dental treatment of certain procedures than career personnel.<sup>26</sup> Spinks and Schneider<sup>26</sup> reported that the

recruit population generally has a much greater backlog of required treatment than the career population. Comprehensive dental work for recruits are not performed until the individual reports to their first duty station. These newly acquainted military personnel are then sent to FTXs to further their training. FTXs are designed to provide the training necessary for personnel to perform their mission during wartime situations. Therefore, assuming that many of the FTXs are mixed with a heavier population of newly acquainted military personnel, the higher rate of dental casualties would be expected. Also, the combination of less intensity, better transportation, and more downtime would increase the accessibility and thus the rate of dental conditions observed in FTXs.

## **RECOMMENDATIONS**

It is recommended that the goal for the Dental Corps be clarified in accordance with Joint Vision 2010 to outline the level of care provided in forward deployment environments. A very broad purpose leads to wide latitude in how the operation is interpreted and executed and makes it difficult to accurately project dental supply requirements.

Better data collection methods and procedures would greatly enhance prediction of resources. The studies surveyed used different criteria to report, collect, and categorize dental casualties. Frequently, population at risk information was not available. The Navy and Marine Corps initiated a Treatment Requirements Program in July 1978 at all 23 Naval Regional Dental Centers worldwide. The program uses a Dental Information System to collect and measure the quantity of dental treatment provided to Navy and Marine Corps personnel.<sup>26</sup> This method captures the procedures performed but not the specific dental conditions that occurred. Because the methods used in sampling, collecting, and analyzing data have not been consistent, it is difficult to make comparisons over time. The use of a standardized method of collecting data similar to that adopted by the Tri-Service Center for Oral Health Studies would overcome comparative limitations of previous military dental health studies and reporting. This approach is more comprehensive in scope than previous military dental health surveys because it includes measures of an individual's dental fitness and dental conditions.

Although after-action reports, research studies, and historical data provide a rich information source to aid in estimating the types of dental casualties that would occur in present and future combat scenarios, they do not incorporate the different factors that could influence the rate of occurrence. Unforeseen factors have a significant impact on the incidence of dental conditions. The use of historical data from previous operations provides only the baseline for projecting casualty incidence for future scenarios. The use of these sources must be quantified. For example, the Kuwait and Vietnam conflicts are separated by more than 20 years. Although personnel there experienced nearly the same incidence of dental casualties, the incidence of dental disease dramatically decreased. The rates seen during Kuwait should receive more consideration than those seen during Vietnam because dental health has improved with time and technology. It is recommended that SMEs determine the factors (recency, operational relevance, transportation, dental fitness, personnel mix) and their weights. A methodology designed to factor in the other properties that influence the rate of dental conditions exhibited in different scenarios will be developed in Phase II.

Lastly, results of dental fitness sick call imply that the best way to minimize dental casualties in a theater is to treat personnel prior to deployment. Dental has an aggressive dental fitness program that currently emphasizes a focus on placing personnel in Classes 1 and 2 and reducing the Class 3 patients. The majority of Marine Corps personnel, as much as 83.3%, are in Class 2. Several studies have shown that the majority of dental conditions are related to caries, pericoronitis, and periodontal disease, which can be prevented with comprehensive dental care prior to deployments. Class 2 personnel may be deployed with minor caries or periodontal disease that may develop into an emergency or sickcall visit. True dental emergencies (abscess, infections, trauma) are less predictable than the incidence of caries. A reduction in the number of deployed personnel with caries, periodontal disease, and wisdom teeth (which constitute the pericoronitis) would greatly increase the fitness of Marine Corps personnel and reduce the high incidence rate of these most observed conditions during all operations.

Determining the likely distribution of dental casualty rates is essential to resource planners and logisticians to determine the amount and composition of dental equipment and supplies required for an operation. The mission of Dental, data collection methodology, and factors that influence dental incidence rates should be considered when estimating dental casualty rates.



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## APPENDIX A: DENTAL CONDITIONS

**Acute necrotizing gingivitis (ANUG)** – An inflammation of the gingiva characterized by necrosis of the papillae, ulceration of the gingival margins, appearance of a pseudomembrane, pain, and a fetid mouth odor.

**Alveolitis/alveolar osteitis (localized)** – Infection of an extraction site (dry socket, localized osteitis).

**Apical abscess/periapical abscess** – Collection of purulent exudate around the area of the tooth that surrounds the root tip.

**Apthous ulcer** – One or more painful ulcers on the lining mucosa.

**Avulsed, mobile, displaced tooth** – Separation or displacement of an entire tooth structure from its supporting and attaching tissues

**Candidiasis** – A fungal infection.

**Caries (no pulp involvement)** – Deterioration of enamel by decay that does not extend to the pulp.

**Caries (pulp involvement)** – Deterioration of enamel by decay that extends to the pulp.

**Cellulitis (oral)** – Inflammation of the subcutaneous tissue caused by group A beta hemolytic streptococci.

**Crown (fractured, loose, or broken)** – Loose, broken, or fractured tooth cap.

**Cutaneous ulcer** – Ulcer(s) of oral or peri-oral tissues.

**Defective restoration** – Deterioration, fracture, or loss of permanent or temporary non-cast restoration.

**Dentin hypersensitivity** – A portion of the protective covering from the hard enamel coating of the tooth is lost causing the odontoblasts to be exposed and hypersensitive to hot and cold substances.

**Food impaction/foreign body** – Food or object that is lodged in gums.

**Fractured alveolar bone** – A break in the bone surrounding a tooth.

**Fractured mandible** – Fracture of the lower jaw.

**Fractured maxilla** – Fracture of the upper jaw.

**Fractured tooth** – A break in the tooth with or without the loss of a portion of the tooth.

**Gingivitis** – Acute or chronic inflammation of the gingiva

**Maxillary sinusitis** – Infection of sinus area accompanied by inflammation and drainage. Conditions may mimic toothache.

**Occlusal trauma** – Trauma to the incisal surface or occlusion of teeth.

**Oral ulcers** – Ulcers that affect the oral cavity, including aphthous ulcer, cold sores, and herpes simplex.

**Osseous sequestrum** – Bone splinters.

**Osteomyelitis** – Microbial infection of the bone marrow.

**Other** – Drug reactions, unspecified infections, and unknown or unspecified conditions.

**Pericoronitis (erupting tooth)** – Acute inflammation of tissue area surrounding tooth, most commonly associated with erupting third molars.

**Periodontitis/periodontal abscess** – Advanced gum disease and inflammation that causes bone loss, resulting in tooth loss if untreated.

**Postoperative problem** – Conditions associated with previous operative treatment, such as bite adjustment.

**Postsurgical problem** – Conditions associated with previous surgical treatment, such as swelling from tooth extraction.

**Prosthesis (broken, loose, or missing)** – Absence, deterioration defect, or fracture of a fixed or removable appliance that replaces missing teeth (eg, bridges, dentures, and partials).

**Pulpitis** – Inflammation of the dental pulp or nerve.

**Root fracture** – Fracture of part of the tooth below the crown.

**Sialadenitis** – Infections of the salivary glands.

**Soft tissue trauma/laceration** – Oral or facial soft tissue abrasion, contusion, or burn.

**Swelling, undetermined origin** – Swelling or inflammation with no apparent origin.

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